COVER CROPS UNDER COCONUTS

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The practice of introducing low-growing plants with dense foliage, under plantation crops is called cover-cropping. It is not well known whether this system was originally an attempt to imitate the natural ground covers of forest. However, the artificially established covers in agriculture are of a more uniform nature than those of the natural forests. Nevertheless both forms can be considered to serve similar purposes. Most of the plants grown as ground covers belong to the two plant orders Gramineae (cereals and grasses) and Leguminosae (leguminous plants). The plants of these groups possess certain characteristics which make them exclusively suitable for cover-cropping.

Cover-crops and Soil-conservation

Erosion is the removal of soil by water or wind. But in the wet tropics, the agriculturist is most concerned with the former agent. Under natural conditions the heterogeneous vegetational covers protect the soil partly by providing shelter against the direct action of rain and wind, and partly by creating a physical soil structure which gives inherent resistance to erosive forces. If the soil is cleared and cultivated without making any provision for protection, it would revert back sooner or later to a condition in which erosion is unavoidable. Under such a condition erosion will appear to have a cumulative effect; since it promotes the run off of surplus water, which in turn will accelerate erosion.

Soil-erosion can be efficiently checked by different methods, of which one method is cover-cropping. A graminaceous ground-cover has the unique advantage of building-up of an erosion-resistant soil structure which persists for some years, after the land is ploughed. In sloping, erodible land, contour strip-covers, alternating with cultivated strips under arable crops, are most effective in checking soil denudation. Grass with their extensive tufts of fibrous roots and those legumes which generally produce adventitious roots at nodes are functionally suited for contour stripping.

The natural ground-covers of most of the coconut growing areas is a heterogeneous vegetation, the composition of which is governed by climatic and other ecological factors. The flora may include a number of common

weeds such as Kuweni (*Cenchrus echinatus*), Aepala (*Sida acuta*), Thora (*Cassia sp.*), Gandhapana (*Hyptis suaveoleus*), Hulangthala (*Ageratum conzsoides*), or even the noxious Illuk (*Imperata cylindrica*). If the chief aim in establishing a ground-cover is conservation of soil, then this inexpensive cover should serve the required purpose, since Illuk itself is believed to be an efficient agent for soil-conservation. But it must be said that much more is expected from an introduced ground-cover, though its resultant bearing on the major crop will depend only on the balance between its advantageous and disadvantageous effects. The following discussion will therefore be directed to bring out the scope and limitations of ground-covers under plantation crops, special reference being made to coconuts.

Moisture Relations of Cover-crops

In the tropics, moisture requirements of cover-crops under arable crops need careful investigation, to determine their ability to stand drought conditions on the one hand and their effects on the major crop on the other hand. Generally, covers with surface feeding roots are subject to severe desiccation, while those with deep tap-roots, are mostly drought-resistant. In selecting covers therefore due consideration should be given to these factors. Under coconuts, a recommended mixture is the quick-growing legume *Calapogonium mucinoides* and the slow-growing, but drought-resistant legume *Centrosema pubescens* (1). The former which establishes itself first smothers the weeds and dies back during the drought, while the latter with its deep-roots appears later and takes its place. Thus by sowing such a mixture, it is possible to establish a permanent ground-cover whose components would appear alternately as the weather conditions alter.

Low-growing and creeping species of leguminous plants which cover the soil by a carpet of foliage, e.g. species of *Calapogonium, Indigofera, Pueraria* and *Vigna* (Cowpea), help to keep the temperature down by shading the soil and reducing direct evaporation from it. When they do not themselves consume too much water, they may be of great importance in adjusting the soil conditions for the growth of the major crop. On the other hand, the increased permeability and porosity resulting from the action of mixed covers on the soil more than compensates for the desiccation caused by the loss of moisture from the foliage of the mixed covers. Experimental evidence has been obtained using *Indigofera endecaphylla* and *Centrosema pubescens* to show that when ground-covers are maintained for shorter periods, i.e. less than 2 years, the loss of moisture during drought from soils under ground-covers is greater up to a depth of 18 inches, than from a weeded bare land (2). The converse has also been shown to be true if the covers are maintained for much longer periods. This may partly explain the observed initial drop in the yield of coconuts when ground-covers are first established (3). Therefore, controlled ground-covers of suitable grass and/or legume crops maintained for longer periods may not show such adverse effects as is generally believed.

Cover-crops and Soil Fertility

Indirect evidence of the beneficial effects of a ground-cover on soil structure is afforded by the recorded instances of increased yields of the major crop and of the decreased erosion. The most striking effects of ley on the soil are also shown in the soils physical properties. This is specially true of the grasses, whose ramifying tufts of fibrous roots improves considerably the 'crumb' structure of the soil, thus effecting good aeration and aiding much micro-organic activity. Furthermore, practical experience has shown that the degree of granulation of a soil is a rough measure of its fertility.

In the tropics where decomposition of organic matter is rapid, maintaining of a suitable organic matter status is a problem which could be effectively solved by growing ground-covers. Under plantation crops such as the coconuts, ground-covers could be ploughed in periodically to effect fertility through increased organic matter and nutrient materials. In this connection, deep-rooted species of legumes play a vital role in bringing up minerals from the lower horizons of the soil, thus raising the nutrient status of the top-soil.

In the proposed manurial experiment on young palms on a virgin jungle soil at Pothukulama, cowpea was grown in the new clearing prior to the planting of coconut seedlings. The analytical data of the shoots, roots, seeds and husks of cowpea which are given in the table below indicate the amount of mineral nutrients used up by this legume.

TABLE

Analytical data to show amounts of N.P. and K removed from Soil by Cowpea

PLANT MATERIAL	*N*			*P*			*K*		
	N/ Acre (lbs.)	*As sulphate of Ammonia/ Acre (lbs.)*	*Per cent*	*P_2O_5/ Acre (lbs.)*	*As Saphos Phosphate/ Acre (lbs.)*	*Per cent*	*K_2O/ Acre (lbs.)*	*As Muriate of Potash/ Acre (lbs.)*	*Per cent*
Shoots ..	31.2	151.5	66.0	1.90	6.80	42.0	48.5	80.8	82.8
Roots ..	1.6	7.8	3.4	0.21	0.75	4.6	2.5	4.2	4.3
Seeds ..	13.5	65.5	28.5	2.30	8.20	50.7	5.6	9.3	9.5
Husks ..	1.0	4.9	2.1	0.12	0.43	2.7	2.0	3.3	3.4
TOTAL ..	47.3	229.7		4.53	16.18		58.6	97.6	

It will be observed from this table, that an average of about 59 lbs. of potash (K_2O) per acre were used up by the plants, as compared to 4.5 lbs. of phosphoric acid (P_2O_5) and 47 lbs. of nitrogen. These values expressed as fertilizer-equivalents, would be approximately 98 lbs. of Muriate of Potash (60 per cent), 16 lbs. of Saphos Phosphate (28 per cent), and 230 lbs. of Sulphate of Ammonia (20.6 per cent), respectively. Thus it would be seen that unless provision is made to incorporate cover-crops into the soil as green manures, there would be a considerable drain on the soils available nutrients. The high nitrogen values, may probably be due to fixation of atmospheric nitrogen by root nodule bacteria. Since most leguminous plants differ from other autotrophic plants in having the property of obtaining nitrogen as an available nutrient from the inert nitrogen in the atmosphere, through the root nodule bacteria. However the N.P.K. Experiment at Bandirippuwa Estate has indicated that if the nitrogen level in the soil is too high, the uptake of potash by coconuts is limited (4). Potash being a dominant requirement for coconuts, such an accumulation of excess nitrogen would be detrimental if the potash level is not stepped up. On the other hand, sulphate of ammonia in the manure mixture being expensive, could be partly replaced by green manures to provide the nitrogen. From the above table, it will also be seen that about 53 per cent of the total phosphoric acid of the plants, is present in the pods (seed + husks), as compared to 13 per cent of potash and 31 per cent of nitrogen. Therefore, harvesting of pods would involve the removal of a greater proportion of phosphoric acid than potash and nitrogen.

Cover-crops and Livestock

Considering the fact that a vast ground space is available under coconuts, it would be interesting to investigate the possibility of rearing cattle or other farm-animals, using soil-covers for rotational grazing. Grazing *in situ*, will provide organic matter in the form of excretory returns which would be in a better state of decomposition than the ploughed-in green manures. This necessitates the use of grass and/or legume covers which would primarily serve as suitable ground-covers and secondarily as a nutritious feed. In Ceylon little effort has been made to introduce mixed covers. Among grasses, *Brachiaria brizantha* has shown great promise and should serve as a useful cover under coconuts. It is also drought resistant and palatable and therefore should serve well as a pasture.

Other species of *Brachiaria* seems to lack the unique combination of characteristics of *B. brizantha*. The use of Napier and Guinea grasses under coconuts as ground covers have not gained much favour due to many reasons. Thus they require heavy manuring and makes considerable demand on potash. Furthermore, the tall foliage of these grasses hinder the

picking and collecting of the coconuts. Among legumes, Tropical Kudzu (*Pueraria phaseoloides*), Cowpea and species of *Centrosema* and *Calapogonium* have been grown successfully. Another legume which could be grown as a cover-crop under coconuts is Velvet bean (*Stizolobium deeringianum*), which is also recommended for rotational grazing (5). Velvet bean can also suppress the growth of sedges and Illuk. Bengal bean (*Stizolobium aterrimum*) is also a species which has shown promise under coconuts, as a soil-cover, for green manuring and also for rotational grazing. It is a drought resistant annual which when established, smothers the weeds and forms a dense cover. Thus the possibility of growing mixed swards under coconuts in Ceylon may not be a difficult task.

Management of Ground-covers

Selection of the appropriate ground-covers and management requires a fair amount of experience and skill. Most legumes require adequate phosphate manures for proper growth. *Pueraria* however is tolerant to acid soils and poor soils defective in lime and phosphates, but reacts well to both organic and inorganic fertilizers. Coconut lands under cover-crops are recommended to be manured by broadcasting. The cover-crops and fertilizer must then be turned into the soil by ploughing or disc harrowing. And when a system of rotational grazing is employed, it will be necessary to increase the rate of fertilizer application to supplement the loss due to assimilation. Disc-harrowing is also done as often as is necessary, but usually about twice a year should suffice, depending on the thickness of the cover. Such cultivation treatments should preferably be done during rainy seasons, so as to provide an opportunity for the covers to regenerate rapidly. It is also recommended that alternate rows and not the entire field be cultivated with implements, because if unfavourable weather conditions intervene, the covers may fail to regenerate (1). Similar precautions should also be taken when soil covers are to be grazed by cattle. Rotational grazing is preferable because heavy grazing may adversely affect regeneration.

In the selection of leguminous ground-covers consideration should be given to the fact that most of these plants do not tolerate shady conditions. Legumes synthesize large quantities of proteins from the nitrogen obtained from the atmosphere. And the effect of shade is to retard the synthesis of carbohydrates, which in turn interferes with the physiological balance between carbohydrates and proteins in the plants. Among the common legumes used as soil covers under coconuts, *Calapogonium* is affected by shade, while *Pueraria* partially endures shade. On the other hand Velvet bean, Bengal bean and *Centrosema* when well established persists well in the shade.

Considering all these facts, it does not seem unlikely that an economical system of cover-cropping could be practised under coconuts, with the necessary practical experience and skill.

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